

Reticulated ceramics improve reactor performance

With many hydroprocessing units being pushed beyond their original design, refiners need to improve the unit's reactor performance. Upgrading reactor top-bed loadings that include reticulated ceramics will improve catalyst performance

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Refiners are facing new challenges every year. One such challenge is the operation of hydroprocessing units that are being pushed beyond their original design. These units are typically processing feedstocks that are different from design, running feed rates considerably higher than design, and operating at a higher severity to meet stricter product specifications.

While this trend is increasing the profitability of the operation, it is simultaneously increasing the difficulty of maintaining the operational stability and reliability of the unit. This demand to improve operational stability has driven the development and utilisation of reticulated ceramics. Improvements in unit performance are realised by incorporating reticulated ceramics into the reactor load.

Crystaphase Technologies Inc is

currently providing reticulated ceramics to more than 30 refineries worldwide under the trade name CatTrap technology. These reticulated ceramics are offered in a wide range of pore sizes that are specifically designed to filter particles in a target size range. This size range can extend from 1-2000 microns. The key to this filtration capability is the tortuous path created by the internal pore structure that readily captures particulates inside the ceramic. These ceramics also have an 85% internal void volume, resulting in a high storage capacity for particles.

The technology uses large-sized ceramics that result in large open channels between the porous disks, such that even after the internal voids of the ceramic are filled with particles there is no restriction of flow. Consequently, at the end of run, the technology does not

contribute to an increase in pressure drop.

More than 100 reactors are currently utilising this technology to increase unit cycle length and the amount of catalyst loaded into the unit. It solves both problems of excessive pressure drop and gas/liquid flow maldistribution that are commonly caused by particles in the feed. The technology has proven its capabilities in a variety of applications, including:

- Vapour, liquid and mixed phases
- Hydrotreating
- Hydrocracking
- Isomerisation
- Naphtha reforming
- Sulphur recovery.

Analytical methods

Standard visual and sample analysis of the reactor material as it is unloaded is

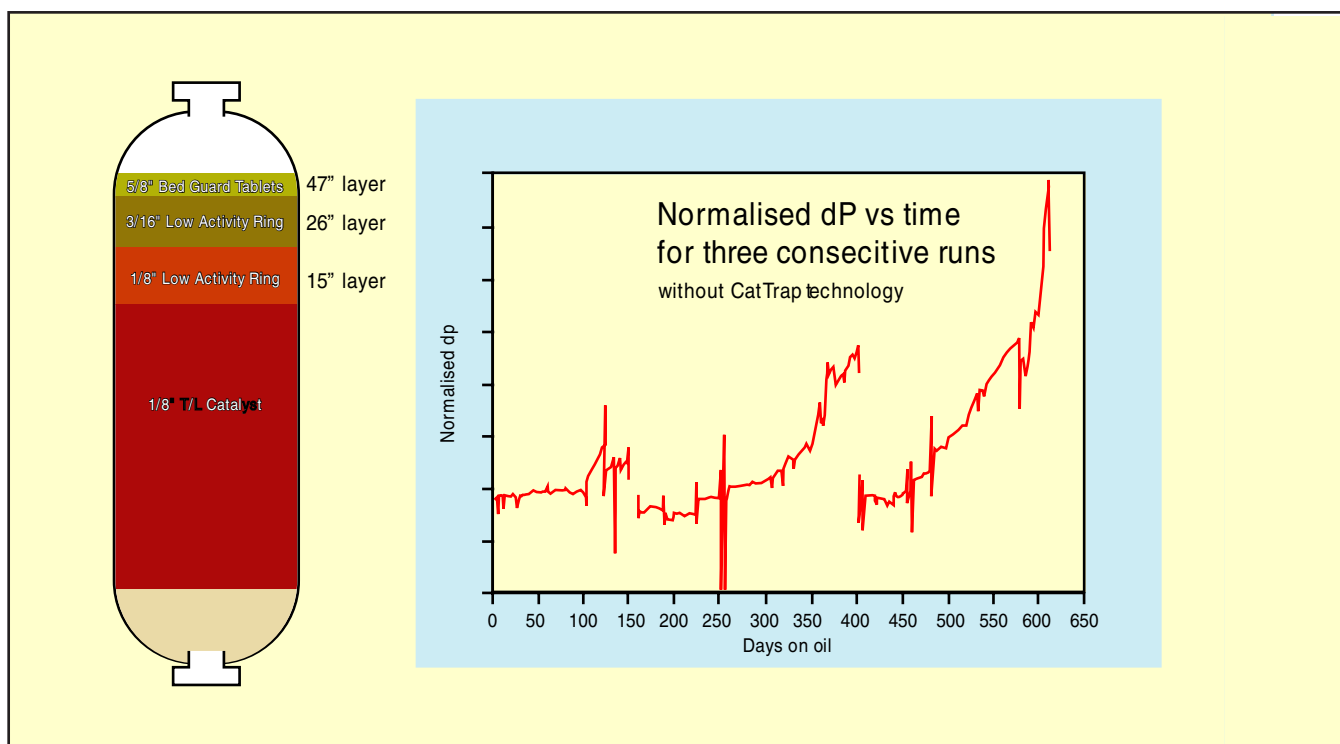


Figure 1 Naphtha hydrotreater (NHT) loading diagram and pressure drop data, utilising conventional ceramic technology rather than reticulated ceramics

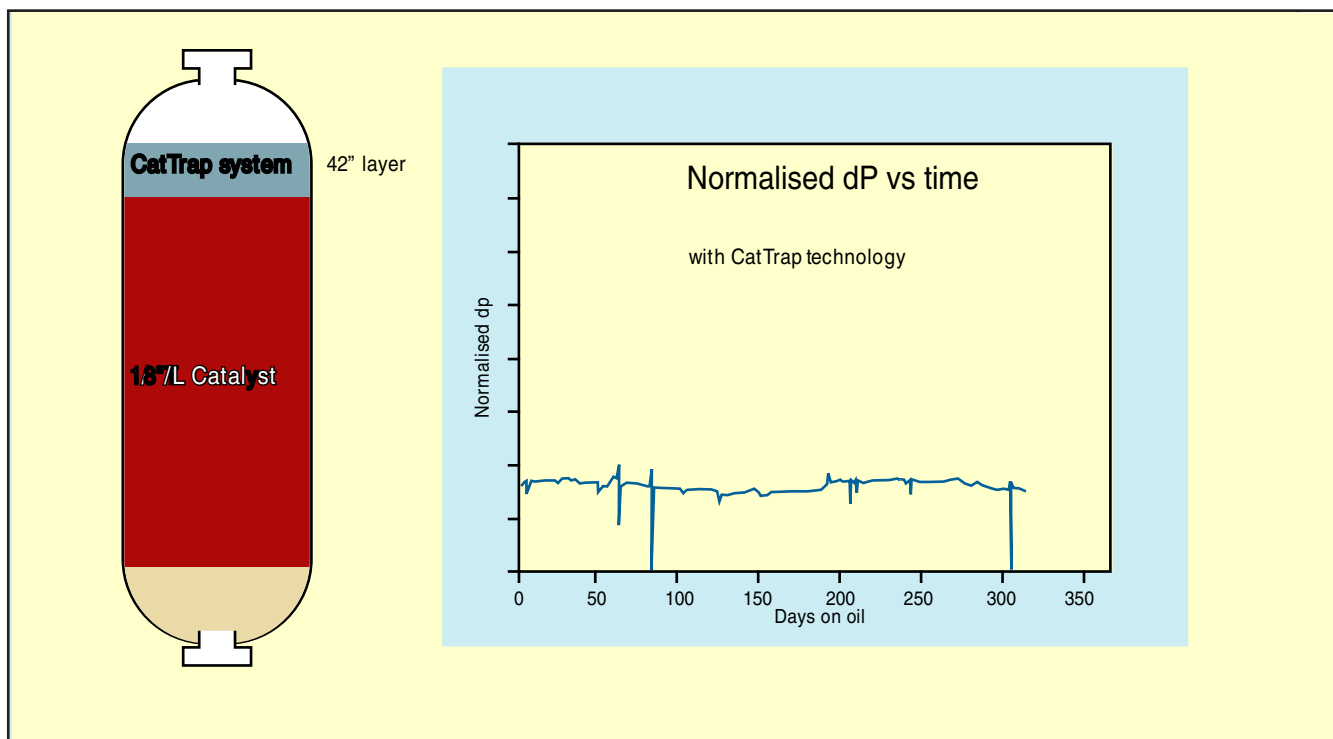


Figure 2 NHT loading diagram and pressure drop data, utilising reticulated ceramic CatTrap technology

critical in determining the proper top-bed loading for a particular reactor. Typically, when a unit is required to shut down for a catalyst change-out, the main focus of the refiner is to minimise the downtime as much as possible. Despite these time constraints, more and more refiners are realising the value of going into the reactor to observe the catalyst unloading and to take samples.

With the introduction of CatTrap technology, new methods have been developed to interpret unloading observations as well as analyse catalyst samples. A variety of analytical tools such as particle-size analysis and SEM (scanning electron microscope) imaging are used to help identify and solve reactor problems such as excessive pressure drop and maldistribution. Some of the potential causes of excessive pressure drop include:

- Distributor tray plugging
- Failure of reactor internals
- Scale or debris at reactor inlet
- Coking of feed
- Coke fines
- Iron sulphide.

Given the vast number of causes of excessive pressure drop, it is paramount to make sure the correct source is identified and addressed.

While these tools can help identify the operational root cause of the problem, in many cases these problems are inherent to the operation of the reactor and cannot be solved without making a large capital investment in additional reactor hardware such as feed

filters and mechanical trays. The alternative of establishing a more rigorous and efficient top-bed system using CatTrap technology has proven more cost effective while still allowing refiners the flexibility of adjusting their top-bed load to meet future operational challenges.

Naphtha hydrotreater

One unit utilising reticulated ceramics is a 30mbpd naphtha hydrotreater processing both coker and straight-run naphtha. The original reactor load involved a comprehensive 88"-layer of conventional ceramic inert wagon wheels and active rings graded on size and activity levels. According to the reactor's pressure drop readings, the past three reactor cycle lengths were limited to 150–225 days on oil before shutdown due to excessive pressure drop. The top-bed load was revised to replace the conventional ceramics with a 42"-layer of CatTrap technology (Figure 2). The reactor ran 300 days on oil until

deactivation of the regenerated catalyst caused the reactor to shut down for catalyst replacement. No pressure drop increase was observed during the entire cycle with the technology.

Refiners do not consider using 20-year-old catalyst technology in their reactors, yet many are still employing 20-year-old conventional-graded ceramic technology, such as wagon wheels and active rings. Now there is the option of replacing these materials with reticulated ceramics in order to keep the reactor operationally stable under increasingly severe conditions. The measurable results are longer unit cycle lengths, improved flow distribution, increased unit catalyst volumes and improved catalytic activity. The true value of reticulated ceramics is their ability to improve operational stability so that the refiners are back in control of the refinery, with unplanned downtimes no longer guzzling resources and dictating scheduling.

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